Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV(NEW) – EXAMINATION – SUMMER 2019

Subject Code:2141406 **Date:15/05/2019**

Subject Name: Food Engineering Transport Phenomenon

Time:02:30 PM TO 05:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			MARKS
Q.1	**(a)**	Define: (i) Atmospheric pressure (ii) Absolute pressure (iii) Guage pressure	**03**
	(b)	Derive the equation for pressure variation in fluid at rest.	**04**
	(c)	A differential manometer is connected at the two points A and B of two pipes. The pipe A contains liquid of specific gravity 1.5 while B contains liquid of specific gravity 0.9. The vertical distance between the axes of two pipes is 3 m. The vertical height of liquid column in the left limb is 5 m. he pressure at A and B are 1kgf/cm^2 and 1.8kgf/cm^2 respectively. Find the difference in mercury level in the differential manometer.	**07**
Q.2	**(a)**	At a certain point in an oil the shear stress is 0.2 N/m^2 and the velocity gradient is 0.21 s^{-1}. If the mass density of the oil is 950 kg/ m^3 find the kinematic viscosity.	**03**
	(b)	What is dimensional homogeneity? Check the dimensional homogeneity of the equation: $V = \sqrt{2gH}$ where V is velocity, g is acceleration due to gravity and H is height.	**04**
	(c)	(i) Describe the phenomena of capillarity rise and fall. (ii) Determine the minimum size of a glass tube, which can be used to measure pressure in water flowing system. The capillary rise in the tube must not exceed 10 mm and surface tension of water- air - glass interface is 0.001 / N m.	**07**
		OR	
	(c)	Using Buckingham's π theorem show that the velocity through a circular orifice is given by $V = \sqrt{2gH}\ \varphi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$ where H is head causing flow, D is diameter of orifice, μ is coefficient of viscosity, ρ is mass density and g is acceleration due to gravity.	**07**
Q.3	**(a)**	Define the term (i) Metacentre (ii) Centre of buoyancy (iii) Vapour pressure	**03**
	(b)	A rectangular pontoon is 5 m long 3 m wide and 1.2 m high. The depth of immersion of pontoon is 0.80 m in sea water. If the centre of gravity is 0.60 m above the bottom of the pontoon, determine the metacentric height. Density of sea water = 1025 kgm^{-3}	**04**
	(c)	Derive the equation for the total pressure and center of pressure for inclined plane surface submerged in liquid.	**07**
		OR	
Q.3	**(a)**	If the equation of a velocity profile over a plate is $v = 5y^2 + y$ (where v is the velocity in m/s) determine the shear stress at $y = 0$ and at $y = 7.5cm$. Given the viscosity of the liquid is 8.35 poise.	**03**

	(b)	What are dimensionless numbers? Derive the equation of Reynolds number and Froude number.	**04**
	(c)	Discuss the conditions of equilibrium of a floating and submerged body.	**07**
Q.4	**(a)**	Calculate : (i) Pressure gradient along the flow (ii) Average velocity (iii) Discharge for an oil of viscosity 0.02 Ns/m^2 flowing between two stationary parallel plates 1m wide maintained 10 mm apart. The velocity midway between the plate is 2m/s.	**03**
	(b)	Prove that the velocity distribution for viscous flow between two parallel plates when both plates are fixed across a section is parabolic in nature.	**04**
	(c)	What is viscous flow? Derive an expression of Hagen Poiseuille equation.	**07**
		OR	
Q.4	**(a)**	Define diffusion and describe in brief about Fick's law of diffusion.	**03**
	(b)	Define: laminar boundary layer, turbulent boundary layer, laminar sub-layer and boundary layer thickness.	**04**
	(c)	Find displacement thickness, momentum thickness and energy thickness for the velocity distribution in boundary layer given by: $u/U = 2(y/\delta) - (y/\delta)^2$	**07**
Q.5	**(a)**	The velocity potential function is given by $Ø = (-xy^3/3) - x^2 + (x^3y/3) + y^2$ (i) Find velocity components in x and y direction (ii) Show that Ø represents possible case of flow	**03**
	(b)	Derive an equation of discharge through Venturi meter.	**04**
	(c)	State Bernoulli's theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's theorem from first principle and state the assumptions made for derivation.	**07**
		OR	
Q.5	**(a)**	Write a short note on rotameter.	**03**
	(b)	Classify notches and derive an equation of discharge for triangular notch.	**04**
	(c)	Define the equation of continuity. Obtain an expression for continuity equation for a three dimensional flow.	**07**